10-16-03

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**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | | |
|---|---|---|
| Application No. | : | 10/604,319 |
| Applicant | : | James G. STANLEY |
| Filed | : | 10 July 2003 |
| Title | : | Method of Attaching a Seat Belt to a Seat Belt Tension Sensor |
| Docket No. | : | 5701-01292 |
| Customer No. | : | 26659 |

**PETITION UNDER 37 CFR 1.53(e)**

14 October 2003

**Mail Stop Missing Parts**
**Commissioner for Patents**
**P.O. Box 1450**
**Alexandria, VA 22313-1450**

Dear Sir:

In response to the Notice of Omitted Item(s) in a Nonprovisional Application (37 CFR 1.53(b)) (**Appendix A**) mailed on 22 September 2003, the undersigned respectfully petitions that the alleged missing items -- i.e. Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14b** described in the specification -- were in fact sent to and received by the USPTO. The undersigned respectfully requests that the actual receipt of these alleged missing items be acknowledged by the USPTO in view of the evidence provided herein and herewith. The undersigned further respectfully requests that the petition fee submitted herewith under 37 CFR § 1.17(h) be either refunded or not charged to the credit card by which payment has been made.

10/21/2003 MBLANCO 00000007 10604319

01 FC:1460 130.00 OP

**Certification under 37 CFR § 1.10**

I hereby certify that this correspondence is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service under 37 CFR § 1.10 on October 14, 2003 and is addressed to: Mail Stop Missing Parts, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Express Mail Label No. ER 515282173 US

Name of Person Mailing: Kurt L. VanVoorhies Signature: Kurt L VanVoorhies Date: October 14, 2003

## Statement of Facts and Evidence that All Items were Received by the USPTO

I, Kurt L. VanVoorhies, do state as follows:

1. On **10 July 2003**, I utilized the USPTO PASAT software, Version 1.1, Build 40 to prepare the above-identified application for electronic filing. All of the files associated with the electronic filing were stored in a common directory, a copy of which is provided herewith in an accompanying **CD-ROM** (**Appendix B**) in a directory thereon named ***ASL292US030710_Source***. In particular, the following table lists the TIF image files included in this directory, which contain images of the drawings in the application as follows:

| TIF File | Drawing Figures |
|---|---|
| *Drawing1.tif* | 1, 2 |
| *Drawing2.tif* | 3, 4 |
| *Drawing3.tif* | 5, 6, 7 |
| *Drawing4.tif* | 8, 9, 10, 11 |
| *Drawing5.tif* | 12, 13a, 13b |
| *Drawing6.tif* | 14a, 14b |
| *Drawing7.tif* | 15a, 15b, 16a, 16b |

2. It is curious that Figures **6** and **7** are alleged to be missing, but not Figure **5**, when in fact images of Figures **5**, **6** and **7** are contained in the same TIF file: *Drawing3.tif*.

3. Prior to saving the output of PASAT in an xml file, I printed and reviewed the application from PASAT. A copy of the resulting printout, provided herewith as **Appendix C**, includes all of the alleged missing Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14b** described in the specification.

4. Prior to submitting the application to the USPTO, I printed the associated attached application file from ePAVE, version 5.1, a copy of which printout is included herewith as **Appendix D**. This printout includes all of the alleged missing Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14** described in the specification although some of the images have been clipped by the associated printing process.

5. On **10 July 2003**, I electronically filed the above-identified application utilizing the USPTO ePAVE software, as evidenced by the associated Acknowledgement Receipt provided herewith in **Appendix E**. This Acknowledgement Receipt provides evidence that all of the drawing files were received by the USPTO as part of the electronic application.

6. A copy of the following associated directory that was created by ePAVE -- i.e. ***C:\Program Files\USPTO\ePAVE\efiling\ASL292US030710***, -- and files contained therein, is provided herewith in the accompanying **CD-ROM** in **Appendix B** in a directory thereon named ***ASL292US030710_ePave***.

7. In addition to explicitly filing Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14b** as part of the original electronic application, the first sentence of the specification includes the statement that "[t]he instant application claims the benefit of prior U.S. Provisional Application Serial No. 60/394,815 filed on **July 10, 2002**, which is incorporated herein by reference." The content of the drawings in U.S. Provisional Application Serial No. 60/394,815 is the same as that of the present non-provisional application. Accordingly, to that extent that any of Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14b** are considered to have not been actually filed with the non-provisional application, then the associated provisional application to which benefit has been claimed can be relied upon by its incorporation by reference for the information of the drawings contained therein.

## Payment of Fees Under 37 CFR § 1.17(h)

Enclosed herewith is a Credit Card Payment Form for payment of the petition fee under 37 CFR § 1.17(h) of **$130**. The Commissioner is authorized to charge any deficiencies -- that cannot be corrected on the Credit Card Payment Form -- to Deposit Account 04-1131. Applicant respectfully requests that, if possible, any refund be made to the credit card listed on the Credit Card Payment Form.

## Summary and Conclusions

In view of the above evidence, the undersigned respectfully requests that the USPTO determine that the alleged missing items -- i.e. Figures **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13a**, **13b**, **14a**, **14b** described in the specification -- were in fact received by the USPTO on 10 July 2003. The undersigned further respectfully requests that the petition fee submitted herewith under 37 CFR § 1.17(h) be either refunded, or not charged to the credit card by which payment has been made.

Respectfully Submitted,

Kurt L. VanVoorhies
Registration No. 38,643
Phone: 248-362-2800
Facsimile: 248-363-2864

Dinnin & Dunn, P.C.
2701 Cambridge Court, Suite 500
Auburn Hills, MI 48326
5701-01292
14 October 2003

**Appendices A-E**

SEP 24 2003

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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| APPLICATION NUMBER | FILING OR 371 (c) DATE | FIRST NAMED APPLICANT | ATTORNEY DOCKET NUMBER |
|---|---|---|---|
| 10/604,319 | 07/10/2003 | James G. Stanley | 5701-01292 |

CONFIRMATION NO. 1318

26659
DINNIN & DUNN, P.C.
2701 CAMBRIDGE COURT, STE. 500
AUBURN HILLS, MI 48326

FORMALITIES LETTER

*OC000000010904584*

Date Mailed: 09/22/2003

# NOTICE OF OMITTED ITEM(S) IN A NONPROVISIONAL APPLICATION

## FILED UNDER 37 CFR 1.53(b)

A filing date has been accorded to the above-identified nonprovisional application papers; however, the following item(s) appear to have been omitted from the application:

- Figure(s) **6,7,8,9,10,11,12,13a,13b,14a,14b** described in the specification.

I. Should applicant contend that the above-noted omitted item(s) was in fact deposited in the U.S. Patent and Trademark Office (USPTO) with the nonprovisional application papers, a copy of this Notice and a petition (and $130.00 petition fee *(37 CFR 1.17(h))*) with evidence of such deposit **must** be filed within **TWO MONTHS** of the date of this Notice. The petition fee will be refunded if is determined that the item(s) was received by the USPTO.

II. Should applicant desire to supply the omitted item(s) and accept the date that such omitted item(s) was filed in the USPTO as the filing date of the above-identified application, a copy of this Notice, the omitted item(s) (with a supplemental oath or declaration in compliance with 37 CFR 1.63 and 1.64 referring to such items), and a petition under 37 CFR 1.182 (with the $130.00 petition fee *(37 CFR 1.17(h))* requesting the later filing date **must** be filed within **TWO MONTHS** of the date of this Notice.

Applicant is advised that generally the filing fee required for an application is the filing fee in effect on the filing date accorded the application and that payment of the requisite basic filing fee on a date later than the filing date of the application requires payment of a surcharge (37 CFR 1.16(e)). To avoid processing delays and payment of a surcharge, applicant should submit any balance due for the requisite filing fee based on the later filing date being requested when submitting the omitted items(s) and the petition (and petition fee) requesting the later filing date.

III. The failure to file a petition (and petition fee) under the above options (I) or (II) within **TWO MONTHS** of the date of this Notice (37 CFR 1.181(f)) will be treated as a constructive acceptance by the applicant of the application as deposited in the USPTO. **THIS TWO MONTH PERIOD IS NOT EXTENDABLE UNDER 37 CFR 1.136(a) or (b)**. In the absence of a timely filed petition in reply to this Notice, the application will maintain a filing date as of the date of deposit of the application papers in the USPTO, and original application papers (*i.e.*, the original disclosure of the invention) will include only those application papers present in the USPTO on the date of deposit.

In the event that applicant elects not to take action pursuant to options (I) or (II) above (thereby constructively electing option (III)), amendment of the specification to renumber the pages consecutively and cancel incomplete sentences caused by any omitted page(s), and/or amendment of the specification to cancel all references to any omitted drawing(s), relabel the drawing figures to be numbered consecutively (if necessary), and correct the

# SPECIFICATION

[Electronic Version 1.2.8]

# METHOD OF ATTACHING A SEAT BELT TO A SEAT BELT TENSION SENSOR

## Cross Reference to Related Applications

The instant application claims the benefit of prior U.S. Provisional Application Serial No. 60/394,815 filed on July 10, 2002, which is incorporated herein by reference.

## Brief Description of Drawings

[0001] In the accompanying drawings:

[0002] FIG. 1 illustrates a top-view of an occupant wearing a seat belt in a vehicle seat, wherein the seat belt incorporates a seat belt tension sensor;

[0003] FIG. 2 illustrates a front-view of a vehicle seat upon which a child seat is secured by a seat belt, wherein the seat belt incorporates a seat belt tension sensor and the vehicle seat incorporates a seat weight sensor;

[0004] FIG. 3 illustrates scenarios associated with various seat belt tensile load ranges;

[0005] FIG. 4 illustrates a cross-sectional view of seat belt tension sensor;

[0006] FIG. 5 illustrates a prior art method of attaching a seat belt to a seat belt tension sensor;

[0007] FIG. 6 illustrates an embodiment of an improved method of attaching a seat belt to a seat belt tension sensor;

[0008] FIG. 7 illustrates a plot of seat belt tension sensor output as a function of seat belt tension comparing the prior art and improved attachments of a webbing of a seat belt to a seat belt tension sensor;

[0009] FIG. 8 illustrates a detail of a portion of a loop of webbing secured by a second set of stitches, for the embodiment of Fig. 6;

[0020] The seat belt 14 illustrated in Fig. 1 generally known as a "three-point" seat belt with a continuous loop lap/shoulder belt -- comprises a lap belt portion 16 and a shoulder belt portion 18, wherein one end of the lap belt portion 16 the seat belt 14 is attached at a "first point"20 to a first anchor 22 secured to the vehicle frame 24, one end of the shoulder belt portion 18 is attached at a "second point"26 to a seat belt retractor 28 secured to the vehicle frame 24, and the other ends of the lap belt portion 16 the shoulder belt portion 18 are located where the seat belt 14 passes through a loop 30 in a latch plate 32 that engages with a buckle 34 that is attached at a "third point"36 to a second anchor 38 secured to the vehicle frame 24. The shoulder belt portion 18 passes through a "D-ring"40 operatively connected to the vehicle frame 24 that guides the shoulder belt portion 18 over a shoulder of the occupant 42.

[0021] The seat belt retractor 28 has a spool that either provides or retracts webbing 12 as necessary to enable the seat belt 14 to placed around the occupant 42 sufficient to engage the latch plate 32 with the buckle 34, and to remove excess slack from the webbing 12. The seat belt retractor 28 provides a nominal tension in the seat belt 14 so that, responsive to a crash that causes the seat belt retractor 28 to lock the webbing 12 thereby preventing further withdrawal, the occupant 42 is restrained by the seat belt 14 relatively earlier in the crash event than would occur had there been slack in the seat belt 14. During the crash event, when restraining the occupant 42, the webbing 12 of the seat belt 14 can be exposed to a relatively high tensile load, the magnitude of which depends upon the severity of the crash and the mass of the occupant 42.

[0022] Referring to Fig. 2, the lap belt portion 16 of a seat belt 14 may also be used to secure a child seat 44, such as a rear facing infant seat 44", to the vehicle seat 46, wherein a locking clip 48 may be used to prevent the shoulder belt portion 18 from sliding relative to the lap belt portion 16 proximate to the latch plate 32. In this case, the lap belt portion 16 is typically secured relatively tight with an associated tensile load greater than the associated comfort limit for an adult so as to hold the child seat 44 firmly in the vehicle seat 46 by compressing the seat cushion thereof, and the shoulder belt portion 18 is not otherwise relied upon for restraint.

[0023] Accordingly, the tensile load in the webbing 12 of the seat belt 14 can be used to discriminate an object on the vehicle seat 46, wherein a tensile load greater than a threshold would be indicative of a child seat 44. Referring to Figs. 1 and 2, a seat belt tension sensor 10 is operatively coupled to a lap belt portion 16 of a webbing 12 of a seat belt 14 at a particular seating location. The seat belt tension sensor 10 and a crash sensor 50 are operatively coupled to a controller 52 that is adapted to control the actuation of a restraint actuator 54 e.g., an air bag inflator 54" -- of a safety restraint system 56 located so as to protect an occupant at the particular seating location. If the tensile load sensed by the seat belt tension sensor 10 is greater than a threshold, then

is greater than a threshold, then the restraint actuator 54 is disabled by the controller 52 regardless of whether or not a crash is detected by the crash sensor 50 or regardless of the measurement from the occupant sensor 58. If the tensile load sensed by the seat belt tension sensor 10 is less than a threshold, then the restraint actuator 54 is enabled or disabled by the controller 52 responsive to a measurement from the occupant sensor 58, which may be compensated responsive to the tensile load sensed by the seat belt tension sensor 10. If the restraint actuator 54 is enabled, then the restraint actuator 54 can be actuated responsive to a crash detected by the crash sensor 50. Alternately, for a controllable restraint actuator 54, e.g. a multi-stage air bag inflator 54", the timing and number of inflator stages inflated can be controlled to effect a reduced inflation rate rather than disabling the air bag inflator 54" responsive to measurements from the occupant sensor 58 and the seat belt tension sensor 10.

[0026] Referring to Fig. 3, the loads to which a seat belt 14 is normally exposed can be classified into four ranges as follows: 1) a low range (I) comprising tensile loads associated with the seat belt 14 being placed directly around a human, 2) a low-intermediate range (II) comprising tensile loads associated with the restraint a child seat 44, 3) a high-intermediate range (III) comprising loads associated with non-crash vehicle dynamics, e.g. braking or rough roads, and 4) a high range (IV) comprising tensile loads associated with restraint forces of a crash event. The low range (I), for example, would normally be limited by the maximum tensile load that an occupant 42 could comfortably withstand. The low-intermediate range (II), for example, would normally be limited by the maximum tensile load that a person could apply to the seat belt 14 while securing a child seat 44 to the vehicle seat 46. Notwithstanding that the seat belt 14 and associated load bearing components can be subject to the high range (IV) tensile loads, a seat belt tension sensor 10 would be useful for controlling a safety restraint system 56 if it were capable of measuring low-intermediate range (II) tensile loads associated with securing a child seat 44 to a vehicle seat 46.

[0027] Referring to Figs. 4-6, an exemplary seat belt tension sensor 10 comprises an assembly of an anchor plate 102, a housing 104, a carriage 106 moveable within the housing 104, and a pair of helical compression springs 108 disposed between the carriage 106 and the housing 104 within associated spring guide cavities 110. The housing 104 engages and is restrained by a pair of fingers 112 extending from the anchor plate 102, and is also attached to the anchor plate 102 with a screw. Openings 114 in the carriage 106, housing 104 and anchor plate 102 are aligned so as form an opening 114 in the assembly to which is attached a loop 116 of webbing 12 of a seat belt 14. The anchor plate 102 further comprises a mounting hole 118 by which the seat belt tension sensor 10 is attached with an anchor bolt 120 to a vehicle frame 24. A proximity or displacement sensor 122 measures the position of the carriage 106 relative to the anchor plate 102. For example, a Hall-effect sensor 122.1 or the like, operatively coupled to the housing 104, cooperates with a pair of magnets 124 that are mounted in

stitches 126 are adapted to be sufficiently strong to safely withstand the full range of tension loads to which the webbing 12 is exposed during the operation of the seat belt 14. For the width of the opening 114 substantially narrower than the nominal width of the webbing 12, the webbing 12 of the loop 116 is bunched or folded together within the opening 114, and fans out 128 from the opening 114 to the first set of stitches 126, on both sides of the seat belt tension sensor 10. For example, the width of the opening 114 may be about half the nominal width of the webbing 12, or less. The bunching of the webbing 12 within the opening 114 generates lateral forces against the sides of the opening 114 in the housing 104 and/or anchor plate 102 when a tension is applied to the webbing 12, which cause associated frictional forces that oppose motion of the webbing 12 relative to the housing 104, which reduce the apparent tension sensed by the seat belt tension sensor 10 as the tension is in the webbing 12 is increased, and which increase the apparent tension sensed by the seat belt tension sensor 10 as the tension is in the webbing 12 is decreased, thereby causing substantial measurement hysteresis as is illustrated in Fig. 7 in the plot of the output of the Hall-effect sensor 122.1 of the seat belt tension sensor 10 as a function of the associated seat belt tension for the seat belt attachment illustrated in Fig. 5.

[0031] Referring to Fig. 6, illustrating an improved method of attaching a seat belt 14 to the seat belt tension sensor 10, the webbing 12 of the loop 116 is bunched or folded together within the opening 114, and is further bunched or folded above the opening 114, e.g. where the webbing 12 follows the outside surfaces of the seat belt tension sensor 10, so as to prevent the webbing 12 from rubbing against the sides of the housing 104 and/or anchor plate 102. For example, in the embodiment illustrated in Fig. 6, a second set of stitches 130 are provided in the loop 116, between the first set of stitches 126 and the restraining end 132 of the housing 104 within the loop 116, so as to prevent the bunched or folded webbing 12 from fanning out from the opening 114. Instead, the second set of stitches 130 substantially prevent the width of the bunched or folded webbing 12 within the opening 114 from expanding with increasing seat belt tension, thereby reducing associated frictional forces against the sides of the opening 114 in the anchor plate 102 or housing 104 that cause associated measurement hysteresis. Referring to Fig. 7, the measurement hysteresis for the embodiment of Fig. 6 is substantially less than that for the embodiment of Fig. 5.

[0032] There are various means that may be used to constrain the width of the webbing 12 along the seat belt tension sensor 10. In the embodiment of Fig. 6, both portions 134, 136 of the webbing 12 of the loop 116 are folded and stitched together with a second set of stitches 130, as further illustrated in Fig. 8.

[0033] Referring to Fig. 9, in another embodiment of an improved method of attaching a seat belt 14 to the seat belt tension sensor 10, the individual portions 134,

116 and to thereby reduce or prevent friction caused by the loop 116 rubbing against the face(s) of the housing 104 and/or anchor plate 102.

[0038] Referring to Figs. 16a and 16b, in yet another embodiment of an improved method of attaching a seat belt 14 to the seat belt tension sensor 10, the openings 114 in the housing 104 and anchor plate 102 are adapted to be sufficiently wider than that of the opening 114 in the carriage 106 so as to keep the bunched or folded webbing 12 of the loop 116 within the opening 114 of the carriage 106 from rubbing against the sides of the openings 114 in the housing 104 and anchor plate 102 when the seat belt 14 is tensioned. This may be combined with either a flange 160 -- or, as illustrated in Fig. 15, a thimble portion 158 -- on the carriage 106 so as to reduce or prevent friction caused by the loop 116 rubbing against the face(s) of the housing 104 and/or anchor plate 102.

[0039] While specific embodiments have been described in detail in the foregoing detailed description and illustrated in the accompanying drawings, those with ordinary skill in the art will appreciate that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. For example, rather than bunching or folding a portion of the webbing, the webbing may be woven so as to locally narrow that portion, wherein the warp fibers are bunched together in the narrowed portion of the webbing and the associated weft fibers are interlaced therewith accordingly. Furthermore, the friction and associated hysteresis between webbing and the seat belt tension sensor may be reduced by interposing a relatively low friction coating or material at a location of sliding contact between the webbing and the seat belt tension sensor. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the invention, which is to be given the full breadth of the appended claims and any and all equivalents thereof.

[0040] We claim:

# Claims

[c1]

1. A method of attaching a seat belt to a seat belt tension sensor, comprising:

a. placing a webbing of the seat belt through an opening in the seat belt tension sensor, wherein said opening extends through a first portion of the seat belt tension sensor and through a carriage of the seat belt tension sensor that is adapted to move relative to said first portion of said seat belt tension sensor responsive to a tension

second portion is adjacent to a second side of the seat belt tension sensor, and said second side is opposite to said first side.

[c5]

5. A method of attaching a seat belt to a seat belt tension sensor as recited in claim 4, wherein the operation of maintaining said portion of said webbing in a bunched or folded condition comprises sewing said bunched or folded first and second portions of said webbing together at a location beyond a restraining end of the seat belt tension sensor.

[c6]

6. A method of attaching a seat belt to a seat belt tension sensor as recited in claim 4, wherein the operation of maintaining said portion of said webbing in a bunched or folded condition comprises sewing said bunched or folded first portion of said webbing at a first location beyond said opening in said first portion of the seat belt tension sensor so as to maintain said first portion in a bunched or folded condition, and sewing said bunched or folded second portion of said webbing at a second location beyond said opening in said first portion of the seat belt tension sensor so as to maintain said second portion in a bunched or folded condition.

[c7]

7. A method of attaching a seat belt to a seat belt tension sensor as recited in claim 4, wherein the operation of maintaining said portion of said webbing in a bunched or folded condition comprises locating said bunched or folded first and second portions of said webbing within at least a portion of a ring located beyond the seat belt tension sensor.

[c8]

8. A method of attaching a seat belt to a seat belt tension sensor as recited in claim 4, wherein the operation of maintaining said portion of said webbing in a bunched or folded condition comprises locating said bunched or folded first portion of said webbing within at least a portion of a first ring located beyond said opening in said first portion of the seat belt tension sensor, and locating said bunched or folded second portion of said webbing within at least a portion of a second ring located beyond said opening in said first portion of the seat belt tension sensor.

[c9]

9. A method of attaching a seat belt to a seat belt tension sensor as recited in claim 8, further comprising separating said at least portions of said first and second rings at a location beyond the seat belt tension sensor by a distance at least as great a thickness of said seat belt tension sensor sufficient to prevent said webbing from generating a non-negligible force over a measurement range as a result rubbing against an outer

16. A method of attaching a seat belt to a seat belt tension sensor as recited in claim - 13, wherein the operation of preventing said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor comprises engaging a portion of said webbing with a thimble portion of said carriage that extends beyond said opening of said first portion of the seat belt tension sensor.

[c17]

17. A method of attaching a seat belt to a seat belt tension sensor as recited in claim - 13, wherein the operation of preventing said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor comprises interposing a relatively low friction material at a location of sliding contact between said webbing and the seat belt tension sensor.

[c18]

18. A method of attaching a seat belt to a seat belt tension sensor as recited in claim - 13, wherein the operation of preventing said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor comprises spreading said webbing with a flange operatively coupled to said carriage, wherein said flange extends beyond an outer surface of said first portion of the seat belt tension sensor..

[c19]

19. A carriage of a seat belt tension sensor, wherein said carriage is adapted to engage a webbing of a seat belt and said carriage is adapted to move relative to a first portion of the seat belt tension sensor in opposition to at least one spring acting between said first portion of the seat belt tension sensor and said carriage, whereby the amount of movement is responsive to a tension in the seat belt, said carriage comprising:

a. an opening adapted to receive the webbing of the seat belt, wherein said opening cooperates with a corresponding opening in said first portion of the seat belt tension sensor; and

b. a protrusion extending from said carriage, wherein with said carriage is installed in the seat belt tension sensor, said protrusion extends beyond an outer surface bounding said first portion of the seat belt tension sensor and spanning across said opening in said first portion of the seat belt tension sensor.

[c20]

# Figures

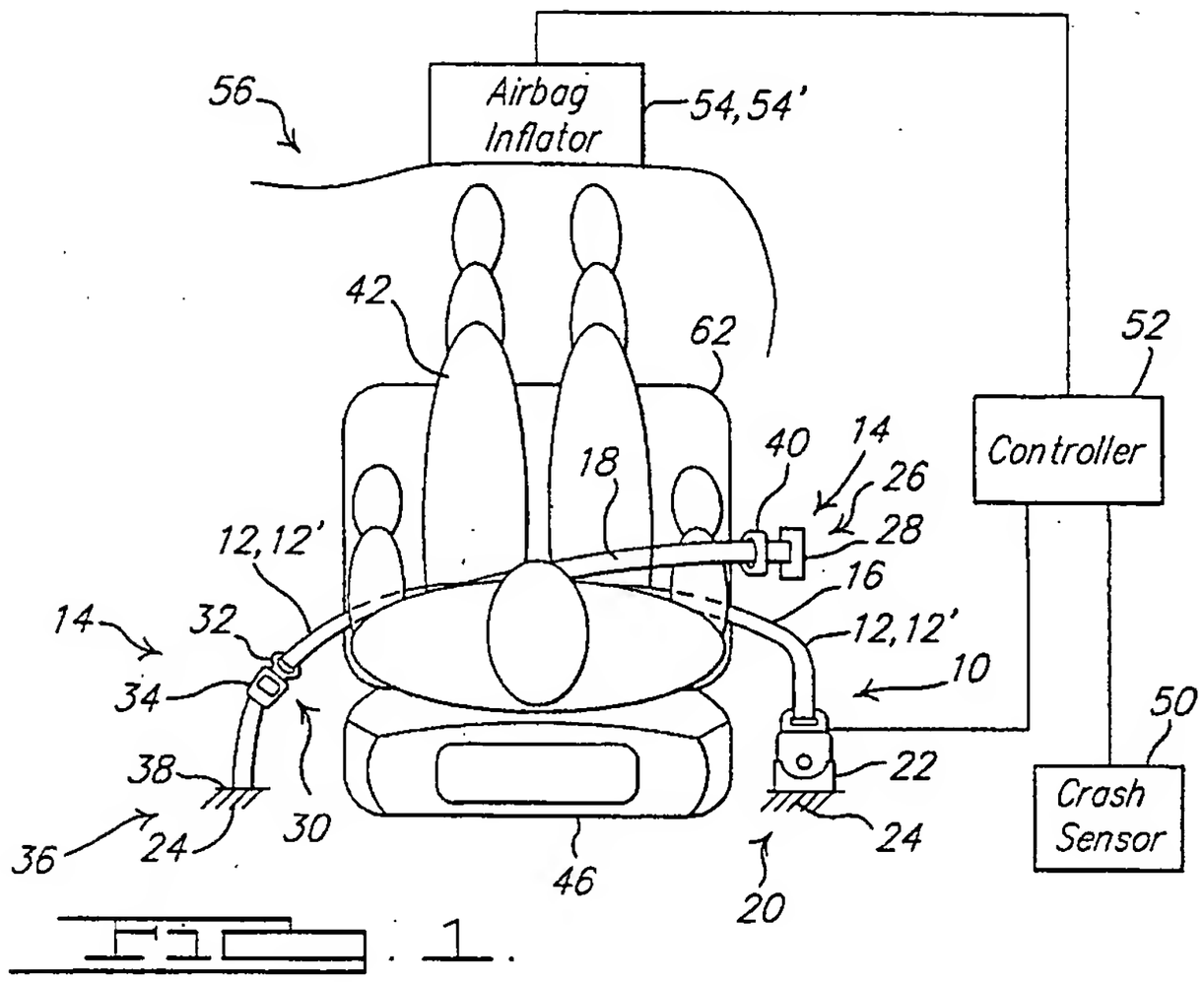



Fig. 1

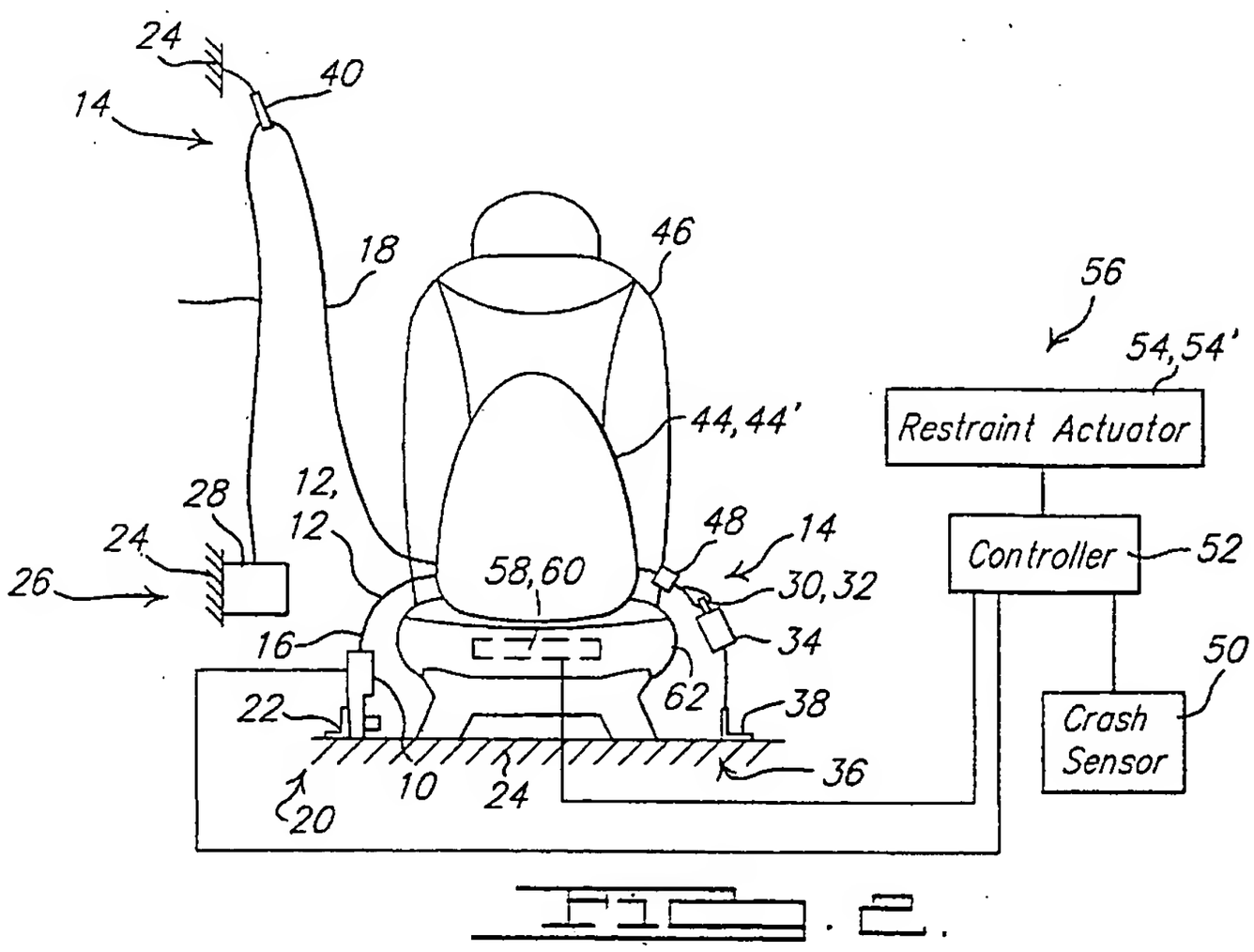
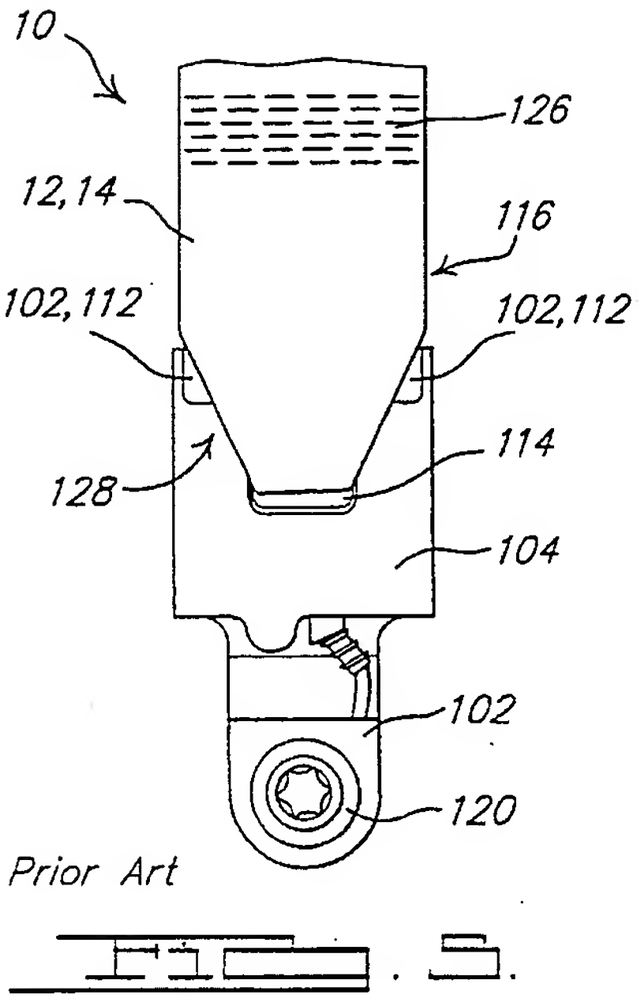



Fig. 2




Prior Art

Fig. 5.

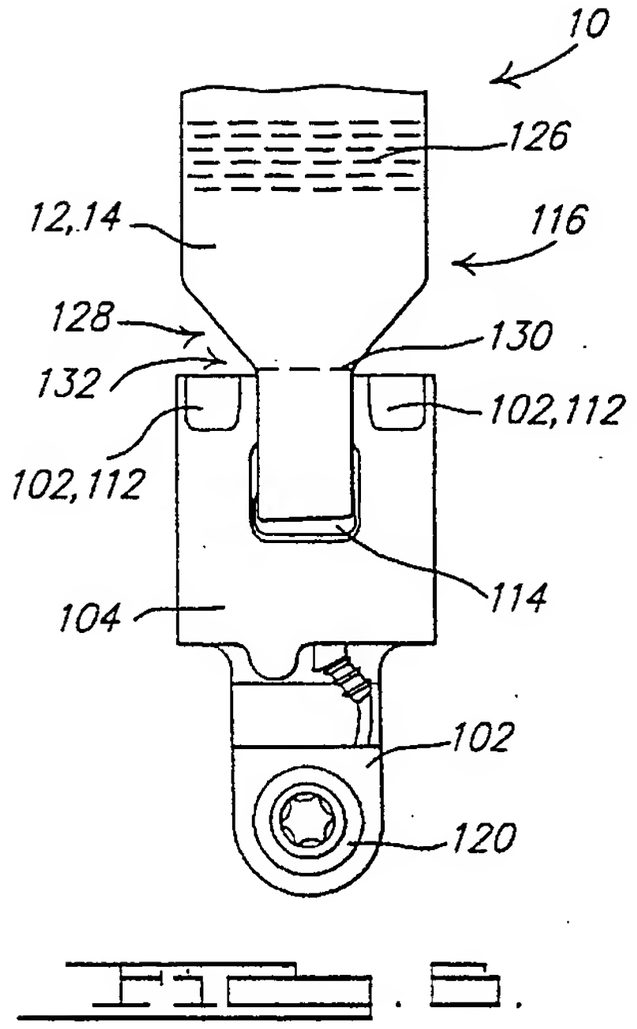



Fig. 6.

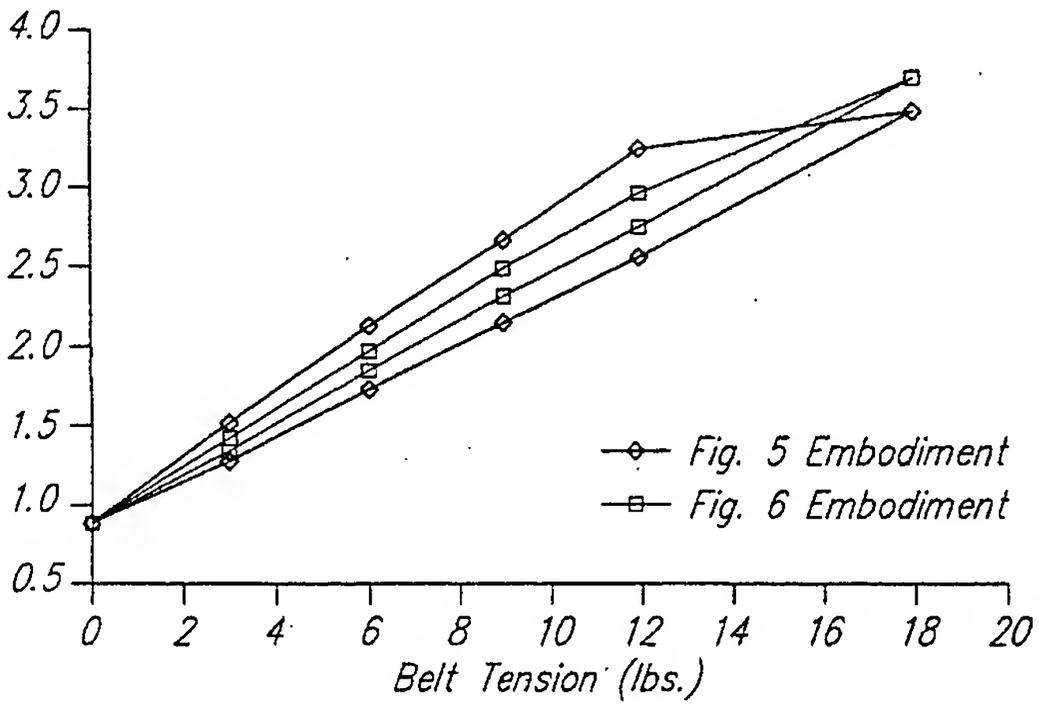



Fig. 7.

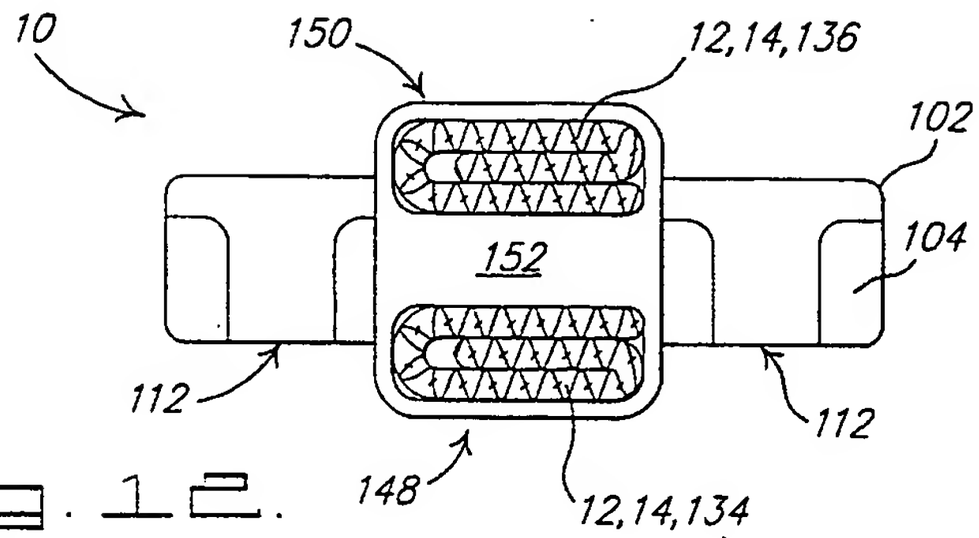



Fig. 12.

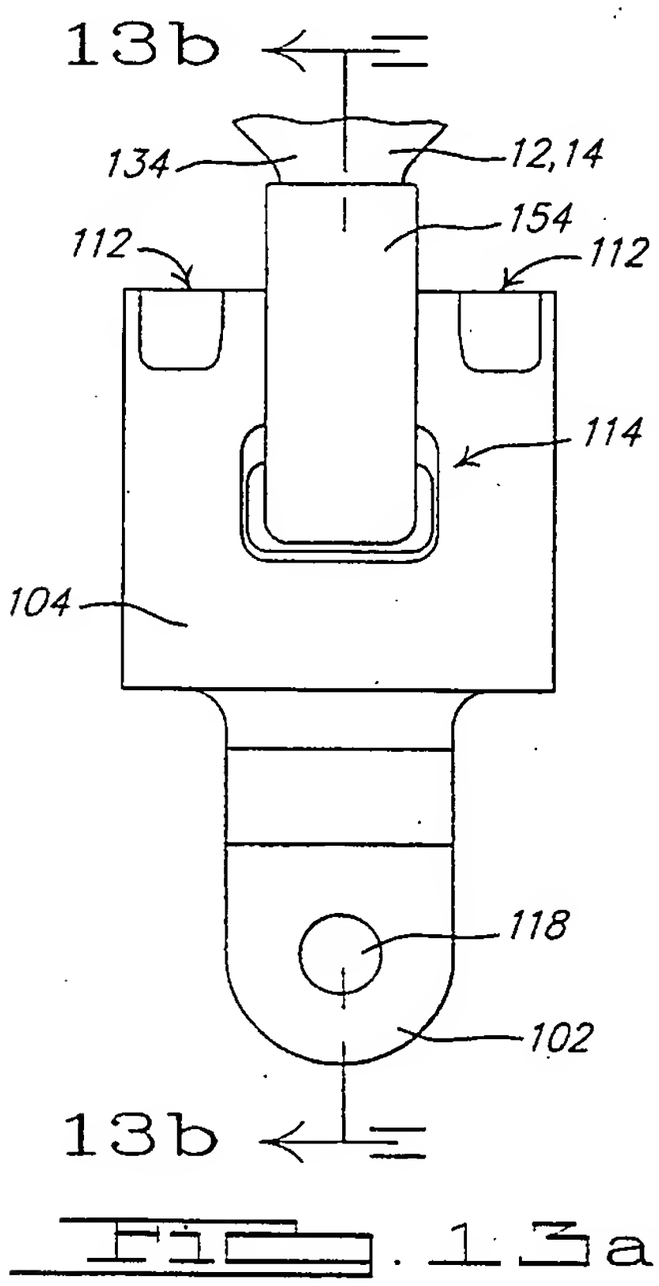



Fig. 13a.

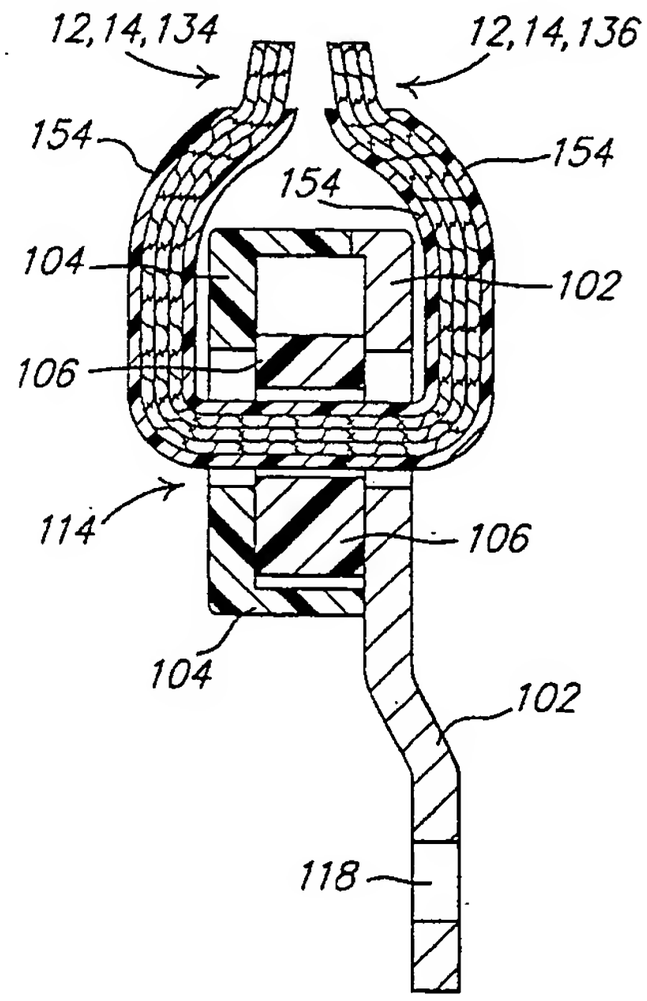



Fig. 13b.

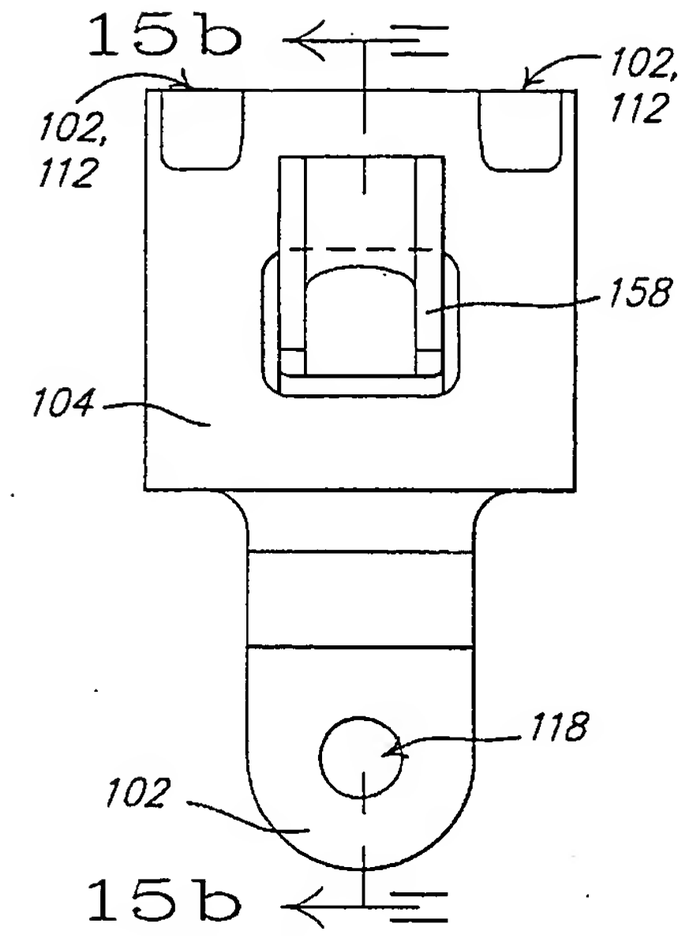



Fig. 15a.

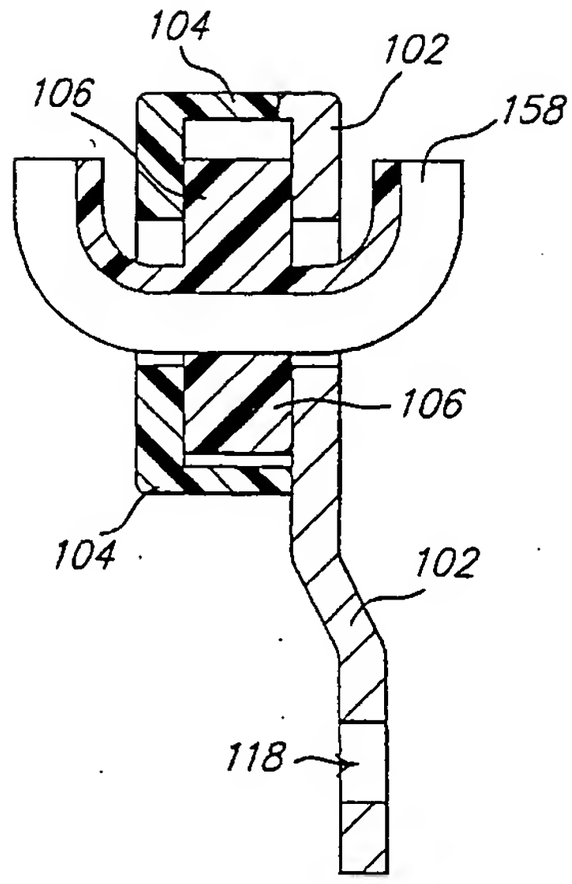



Fig. 15b.

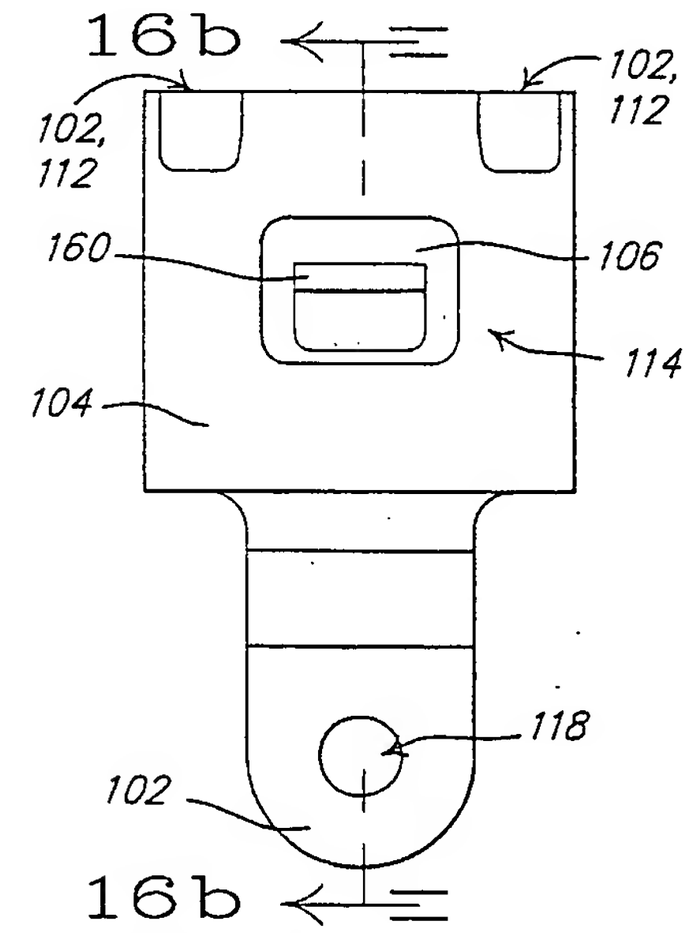



Fig. 16a.

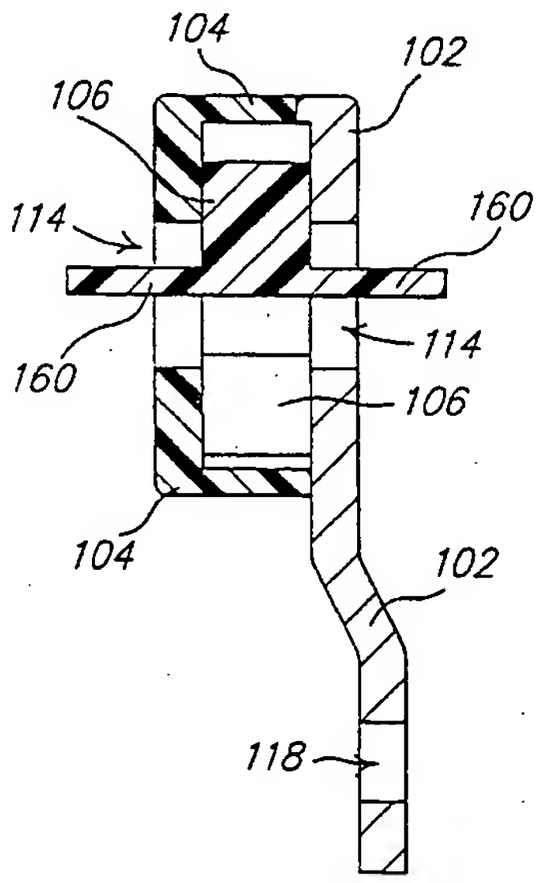



Fig. 16b.

Electronic Version

Stylesheet Version v1.1.1

# Description

# METHOD OF ATTACHING A SEAT BELT TO A SEAT BELT TENSION SENSOR

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The instant application claims the benefit of prior U.S. Provisional Application Serial No. 60/394,815 filed on July 10, 2002, which is incorporated herein by reference.

## BRIEF DESCRIPTION OF DRAWINGS

[0002] In the accompanying drawings:

[0003] *FIG. 1* illustrates a top-view of an occupant wearing a seat belt in a vehicle seat, wherein the seat belt incorporates a seat belt tension sensor;

[0004] *FIG. 2* illustrates a front-view of a vehicle seat upon which a child seat is secured by a seat belt, wherein the seat belt incorporates a seat belt tension sensor and the vehicle seat incorporates a seat weight sensor;

[0005] *FIG. 3* illustrates scenarios associated with various seat belt tensile load ranges;

[0006] *FIG. 4* illustrates a cross-sectional view of seat belt tension sensor;

[0015] *FIGs. 13a* and *13b* illustrate yet another method of attaching a seat belt to the seat belt tension sensor, wherein a loop of webbing is bunched or folded within a sleeve that engages a carriage of the seat belt tension sensor;

[0016] *FIGs. 14a* and *14b* illustrate yet another method of attaching a seat belt to the seat belt tension sensor, wherein a loop of webbing is bunched or folded around a thimble that engages a carriage of the seat belt tension sensor;

[0017] *FIGs. 15a* and *15b* illustrate yet another method of attaching a seat belt to the seat belt tension sensor, wherein a loop of webbing is bunched or folded around a thimble portion of a carriage of the seat belt tension sensor; and

[0018] *FIGs. 16a* and *16b* illustrate yet another method of attaching a seat belt to the seat belt tension sensor, wherein the opening of the housing and anchor plate are adapted to reduce or prevent friction from the loop of webbing therewith.

## DETAILED DESCRIPTION

[0019]

There exists a need for measuring a tensile load in a flexible load bearing element, such as a webbing, cable, rope or thread. As an example, there exists a need to measure a tensile load in a seat belt used in vehicular safety restraint system, wherein the seat belt load measurement can be used to distinguish a type of object secured by the seat belt, or can be used to compensate for the affect of seat belt

responsive to a crash that causes the *seat belt retractor 28* to lock the *webbing 12* thereby preventing further withdrawal, the *occupant 42* is restrained by the *seat belt 14* relatively earlier in the crash event than would occur had there been slack in the *seat belt 14*. During the crash event, when restraining the *occupant 42*, the *webbing 12* of the *seat belt 14* can be exposed to a relatively high tensile load, the magnitude of which depends upon the severity of the crash and the mass of the *occupant 42*.

[0023] Referring to *Fig. 2*, the *lap belt portion 16* of a *seat belt 14* may also be used to secure a *child seat 44*, such as a *rear facing infant seat 44"*, to the *vehicle seat 46*, wherein a *locking clip 48* may be used to prevent the *shoulder belt portion 18* from sliding relative to the *lap belt portion 16* proximate to the *latch plate 32*. In this case, the *lap belt portion 16* is typically secured relatively tight with an associated tensile load greater than the associated comfort limit for an adult so as to hold the *child seat 44* firmly in the *vehicle seat 46* by compressing the seat cushion thereof, and the *shoulder belt portion 18* is not otherwise relied upon for restraint.

[0024] Accordingly, the tensile load in the *webbing 12* of the *seat belt 14* can be used to discriminate an object on the *vehicle seat 46*, wherein a tensile load greater than a threshold would be indicative of a *child seat 44*. Referring to *Figs. 1* and *2*, a *seat belt tension sensor 10* is operatively coupled to a *lap belt portion 16* of a *webbing 12* of a *seat belt 14* at a particular seating location. The *seat belt tension sensor 10*

*62*, or measure the total weight of the seat. In either case, a tensile load in the *seat belt 14* that is reacted by the *vehicle frame 24* acts to increase the load upon the *seat cushion 62*, thereby increasing the apparent load sensed by the *seat weight sensor 60*. The apparent load is increased by each reaction force, so that a given tensile load in the *seat belt 14* could increase the apparent load sensed by the *seat weight sensor 60* by as much as twice the magnitude of the tensile load. Accordingly, in a system with both a *seat belt tension sensor 10* and a *seat weight sensor 60*, the seat weight measurement from the *seat weight sensor 60* can be compensated for the effect of tensile load in the *seat belt 14* so as to provide a more accurate measure of occupant weight, by subtracting, from the seat weight measurement, a component of seat weight caused by, or estimated to have been caused by, the tensile load measured by the *seat belt tension sensor 10*. If the seat weight measurement from the *seat weight sensor 60* is not compensated for the effect of the tensile load in the *seat belt 14*, a *child seat 44* secured to a *vehicle seat 46* with a *seat belt 14* could cause a load on the *seat weight sensor 60* that is sufficiently high to approximate that of a small adult, so that an uncompensated seat weight measurement might cause the associated *restraint actuator 54* to be erroneously enabled in a system for which the *restraint actuator 54* should be disabled when a *child seat 44* is on the *vehicle seat 46*.

[0026] In a system that compensates for the affect of seat belt tension on an *occupant sensor 58*, the *seat belt tension sensor 10*, the *occupant*

placed directly around a human, 2) a *low-intermediate range (II)* comprising tensile loads associated with the restraint a *child seat 44*, 3) a *high-intermediate range (III)* comprising loads associated with non-crash vehicle dynamics, e.g. braking or rough roads, and 4) a *high range (IV)* comprising tensile loads associated with restraint forces of a crash event. The *low range (I)*, for example, would normally be limited by the maximum tensile load that an *occupant 42* could comfortably withstand. The *low-intermediate range (II)*, for example, would normally be limited by the maximum tensile load that a person could apply to the *seat belt 14* while securing a *child seat 44* to the *vehicle seat 46*. Notwithstanding that the *seat belt 14* and associated load bearing components can be subject to the *high range (IV)* tensile loads, a *seat belt tension sensor 10* would be useful for controlling a *safety restraint system 56* if it were capable of measuring *low-intermediate range (II)* tensile loads associated with securing a *child seat 44* to a *vehicle seat 46*.

[0028] Referring to *Figs. 4-6*, an exemplary *seat belt tension sensor 10* comprises an assembly of an *anchor plate 102*, a *housing 104*, a *carriage 106* moveable within the *housing 104*, and a pair of *helical compression springs 108* disposed between the *carriage 106* and the *housing 104* within associated *spring guide cavities 110*. The *housing 104* engages and is restrained by a pair of *fingers 112* extending from the *anchor plate 102*, and is also attached to the *anchor plate 102* with a screw. *Openings 114* in the *carriage 106*, *housing 104* and

displacement characteristic of the *helical compression springs 108*, which provides for generating a measure of seat belt tension from a measure of displacement of the *carriage 106* relative to the *housing 104* and *anchor plate 102*. The *webbing 12* of a *seat belt 14* moves with the *carriage 106* relative to the *housing 104* responsive to a tension in the *seat belt 14*. More particularly, the *webbing 12* slides over the surface of the *seat belt tension sensor 10* (e.g. *housing 104* and *anchor plate 102*) responsive to this motion, thereby generating associated frictional forces in a direction that is opposite to the direction of motion. These frictional forces cause an associated hysteresis in the output signal from the *Hall-effect sensor 122.1*, i.e. a dependence of the output upon whether the seat belt tension is increasing or decreasing, as illustrated in *Fig. 7*.

[0030] Stated in another way, the *seat belt tension sensor 10* comprises an assembly of a first portion of the *seat belt tension sensor 10*, and a *carriage 106* moveable relative thereto, wherein *openings 114* in the first portion i.e. *openings 114* in the *anchor plate 102* and *housing 104* -- cooperate with the *opening 114* in the *carriage 106*. A *seat belt 14* looped through the *opening 114* in the first portion of the *seat belt tension sensor 10*, if not otherwise constrained, is susceptible of generating non-negligible frictional forces and associated hysteresis as a result of rubbing against either a side or an outer surface of the *opening 114* in the first portion of the *seat belt tension sensor 10*, responsive to a tension load applied to the *seat belt 14*.

*tension sensor 10* as the tension is in the *webbing 12* is decreased, thereby causing substantial measurement hysteresis as is illustrated in *Fig. 7* in the plot of the output of the *Hall-effect sensor 122.1* of the *seat belt tension sensor 10* as a function of the associated seat belt tension for the seat belt attachment illustrated in *Fig. 5*.

[0032] Referring to *Fig. 6*, illustrating an improved method of attaching a *seat belt 14* to the *seat belt tension sensor 10*, the *webbing 12* of the *loop 116* is bunched or folded together within the *opening 114*, and is further bunched or folded above the *opening 114*, e.g. where the *webbing 12* follows the outside surfaces of the *seat belt tension sensor 10*, so as to prevent the *webbing 12* from rubbing against the sides of the *housing 104* and/or *anchor plate 102*. For example, in the embodiment illustrated in *Fig. 6*, a *second set of stitches 130* are provided in the *loop 116*, between the *first set of stitches 126* and the *restraining end 132* of the *housing 104* within the *loop 116*, so as to prevent the bunched or folded *webbing 12* from fanning out from the *opening 114*. Instead, the *second set of stitches 130* substantially prevent the width of the bunched or folded *webbing 12* within the *opening 114* from expanding with increasing seat belt tension, thereby reducing associated frictional forces against the sides of the *opening 114* in the *anchor plate 102* or *housing 104* that cause associated measurement hysteresis. Referring to *Fig. 7*, the measurement hysteresis for the embodiment of *Fig. 6* is substantially less than that for the embodiment of *Fig. 5*.

*stitches 126*, wherein one or both *rings 144*, *146* may be either closed as illustrated in *Fig. 11*, or open -- e.g. along a portion of one side thereof -- but with sufficient rigidity and shaped so as to maintain the bunched or folded condition of the *webbing 12* within the respective *rings 144*, *146*.

[0037] Referring to *Fig. 12*, in yet another embodiment of an improved method of attaching a *seat belt 14* to the *seat belt tension sensor 10*, each *portion 134, 136* of the *webbing 12* of the *loop 116* is bunched or folded within a respective *ring portion 148, 150*, located between the *seat belt tension sensor 10* and the *first set of stitches 126*, wherein the *ring portions 148, 150* are separated by a *spacer 152* that keeps the *loop 116* sufficiently open so as to reduce rubbing and associated frictional forces between the *loop 116* and the surfaces of the *housing 104* and/or *anchor plate 102*, wherein one or both *ring portions 148*, *150* may be either closed as illustrated in *Fig. 12*, or open -- e.g. along a portion of one side thereof -- but with sufficient rigidity and shaped so as to maintain the bunched or folded condition of the *webbing 12* within the respective *ring portions 148*, *150*.

[0038] Referring to *Figs. 13a* and *13b*, in yet another embodiment of an improved method of attaching a *seat belt 14* to the *seat belt tension sensor 10*, the *loop 116* of *webbing 12* is fed through a *sleeve 154*, e.g. of plastic, that engages the *carriage 106* of the *seat belt tension sensor 10* and keeps the *webbing 12* bunched or folded therein so as to prevent the *loop 116* from rubbing against the sides of the *opening*

drawings, those with ordinary skill in the art will appreciate that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. For example, rather than bunching or folding a portion of the webbing, the webbing may be woven so as to locally narrow that portion, wherein the warp fibers are bunched together in the narrowed portion of the webbing and the associated weft fibers are interlaced therewith accordingly.

Furthermore, the friction and associated hysteresis between webbing and the seat belt tension sensor may be reduced by interposing a relatively low friction coating or material at a location of sliding contact between the webbing and the seat belt tension sensor. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the invention, which is to be given the full breadth of the appended claims and any and all equivalents thereof.

[0041] We claim:

tension sensor.

[c3] *3.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *2*, wherein the operation of constraining the width of a portion of webbing along the seat belt tension sensor to be narrower than the width of said opening in said first portion of the seat belt tension sensor comprises adapting said opening in said first portion of the seat belt tension sensor to be sufficiently wider than opening of carriage so as to prevent said webbing from contacting a side of said opening in said first portion of the seat belt tension sensor responsive to said tension load applied to said webbing.

[c4] *4.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *2*, wherein the operation of constraining the width of a portion of webbing along the seat belt tension sensor to be narrower than the width of said opening in said first portion of the seat belt tension sensor comprises:

a. bunching or folding a portion of said webbing adjacent to the seat belt tension sensor so that said portion of said webbing that is bunched or folded is narrower than said opening in said first portion of the seat belt tension sensor; and

b. maintaining said portion of said webbing in a bunched or folded condition, wherein said portion of said webbing comprises a first portion and a second portion, said first

comprises locating said bunched or folded first and second portions of said webbing within at least a portion of a ring located beyond the seat belt tension sensor.

[c8] *8.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *4*, wherein the operation of maintaining said portion of said webbing in a bunched or folded condition comprises locating said bunched or folded first portion of said webbing within at least a portion of a first ring located beyond said opening in said first portion of the seat belt tension sensor, and locating said bunched or folded second portion of said webbing within at least a portion of a second ring located beyond said opening in said first portion of the seat belt tension sensor.

[c9] *9.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *8*, further comprising separating said at least portions of said first and second rings at a location beyond the seat belt tension sensor by a distance at least as great a thickness of said seat belt tension sensor sufficient to prevent said webbing from generating a non-negligible force over a measurement range as a result rubbing against an outer surface of said first portion of the seat belt tension sensor responsive to said tension load applied to said webbing.

[c10] *10.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *2*, wherein the operation of constraining the width of a portion of webbing along the seat belt

said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor comprises engaging a portion of said webbing with a thimble, wherein said thimble is adapted to engage said carriage of the seat belt tension sensor.

[c15] *15.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *14*, wherein said thimble is adapted so as to be free of contact with said first portion of the seat belt tension sensor responsive to said tension load applied to said webbing.

[c16] *16.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *13*, wherein the operation of preventing said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor comprises engaging a portion of said webbing with a thimble portion of said carriage that extends beyond said opening of said first portion of the seat belt tension sensor.

[c17] *17.* A method of attaching a seat belt to a seat belt tension sensor as recited in claim *13*, wherein the operation of preventing said webbing from generating a non-negligible force over the measurement range as a result of rubbing against an outer surface of said first portion of the seat belt tension sensor

protrusion extends beyond an outer surface bounding said first portion of the seat belt tension sensor and spanning across said opening in said first portion of the seat belt tension sensor.

[c20] *20.* A carriage of a seat belt tension sensor as recited in claim *19*, wherein said protrusion comprises at least one flange.

[c21] *21.* A carriage of a seat belt tension sensor as recited in claim *20*, wherein said opening in said carriage is sufficiently narrower than said corresponding opening in said first portion of the seat belt tension sensor so as to prevent said webbing from rubbing against a side of said corresponding opening in said first portion of the seat belt tension sensor responsive to a tension load applied to said webbing.

[c22] *22.* A carriage of a seat belt tension sensor as recited in claim *19*, wherein said protrusion comprises a thimble portion.

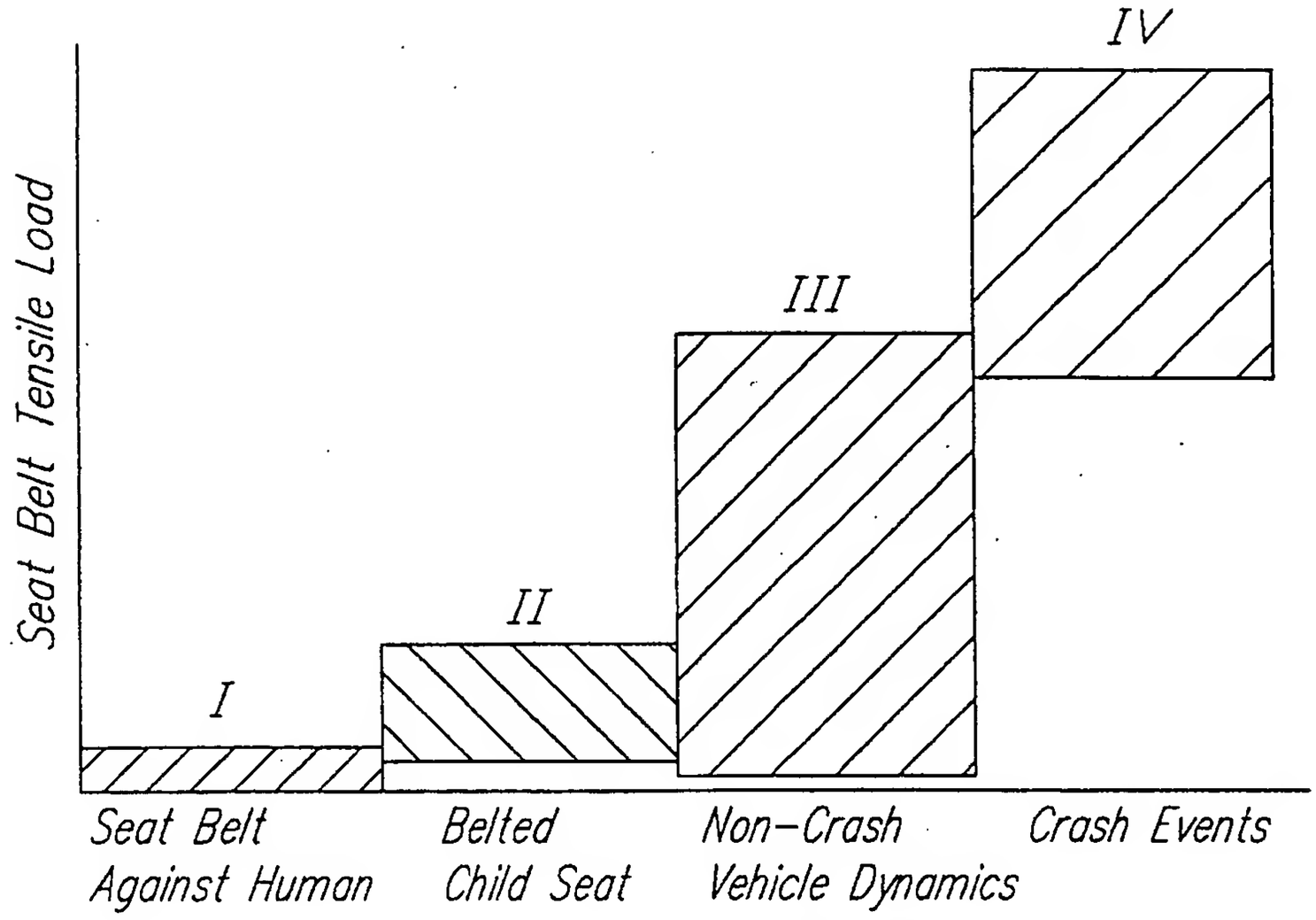
[c23] *23.* A carriage of a seat belt tension sensor as recited in claim *22*, wherein said thimble portion comprises a groove, said groove is adapted to receive a portion of said webbing of said seat belt, and said thimble portion and said groove are adapted to prevent said webbing from contacting a side of said opening in said first portion of the seat belt tension sensor responsive to a tension load applied to said webbing.

[c24] *24.* A carriage of a seat belt tension sensor as recited in claim

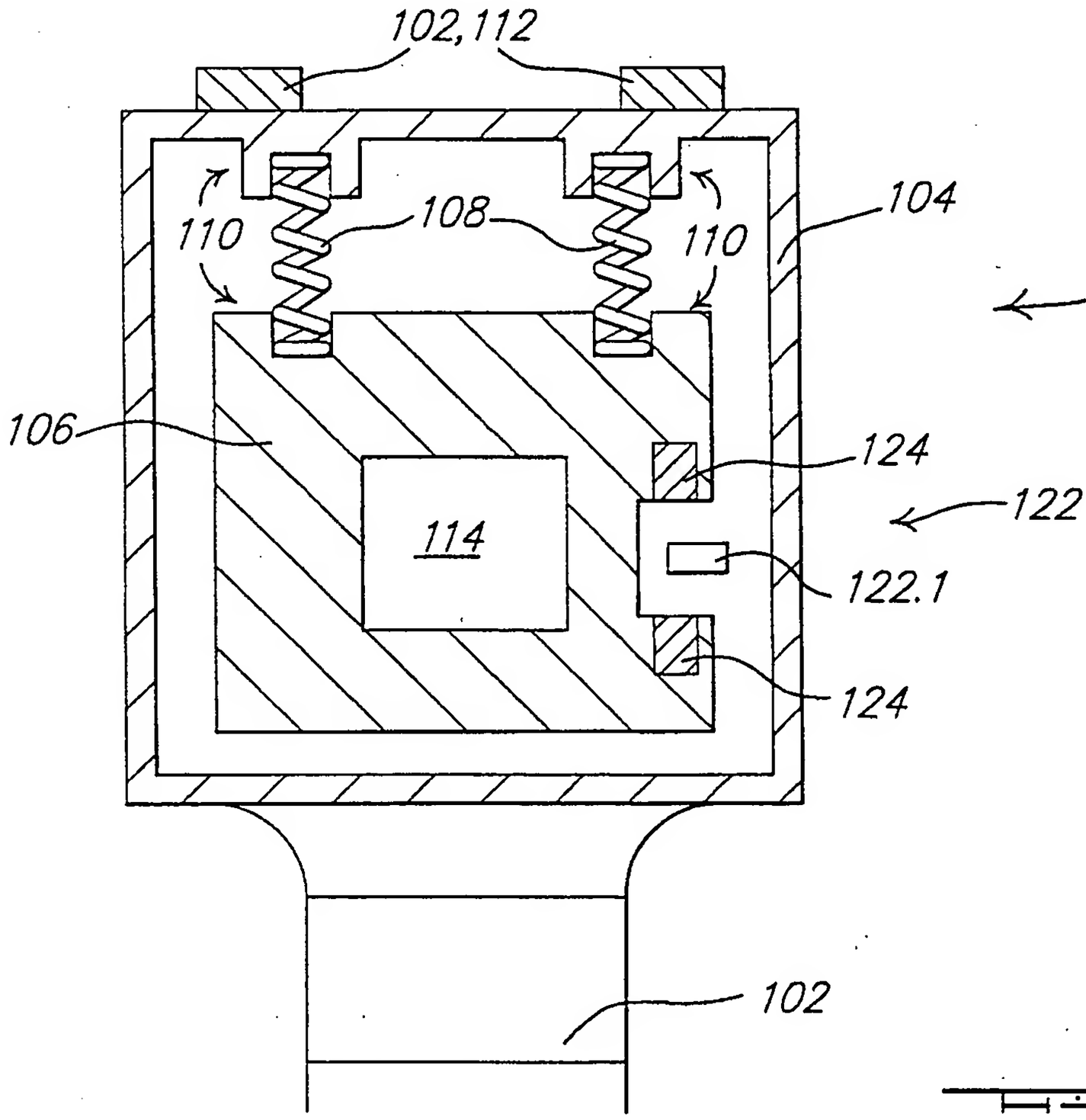
# METHOD OF ATTACHING A SEAT BELT TO A SEAT BELT TENSION SENSOR

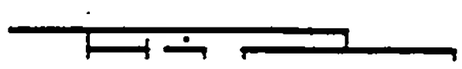
## Abstract

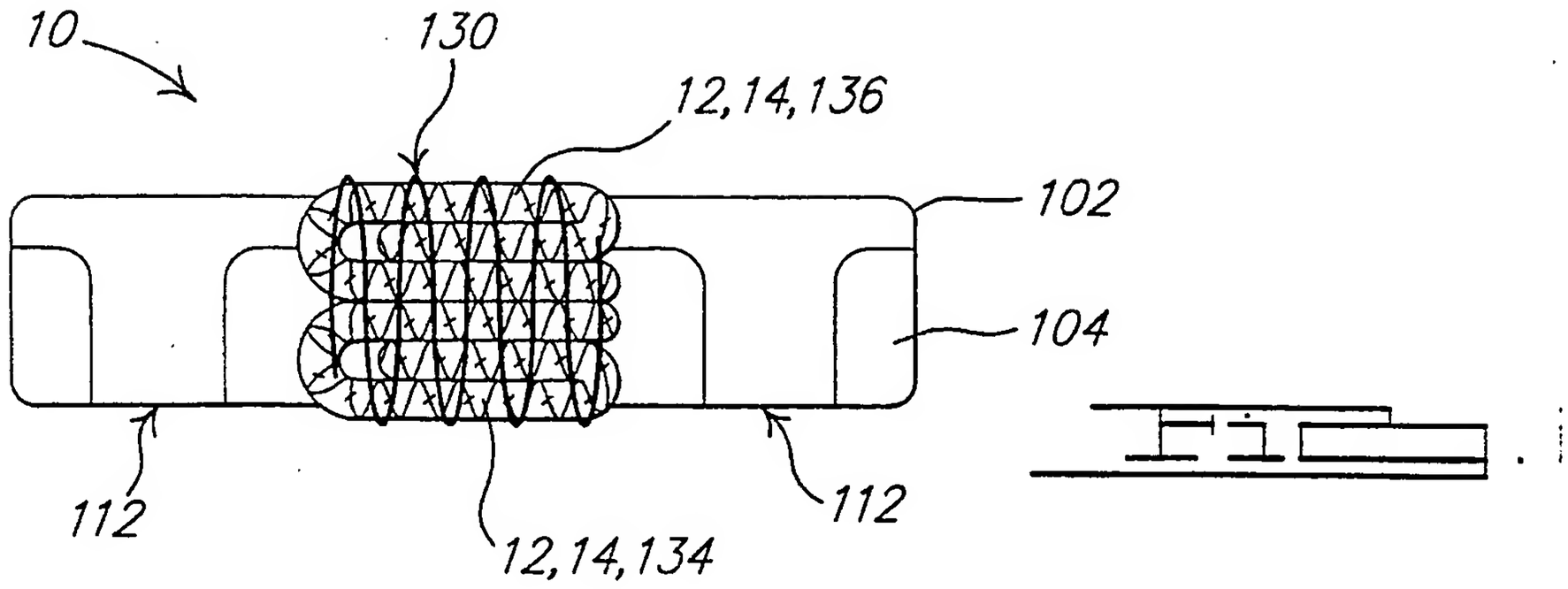
A webbing of a seat belt engages an opening of a seat belt tension sensor. In one embodiment, the webbing is bunched or folded so as to prevent rubbing against the sides of the opening in the housing and anchor plate, or an outer surface of the seat belt tension sensor. The webbing is maintained in a bunched or folded state using either a set of stitches between the two portions of the webbing of the loop; separate sets of stitches in the respective separate portions; a ring enclosing the two portions; separate rings, or ring portions separated by a spacer, enclosing the respective separate portions; or a sleeve, thimble, or thimble portion of the carriage of the seat belt tension sensor engaging the bunched or folded webbing. In another embodiment, the openings in the housing and anchor plate are sufficiently wider than the opening in the carriage, and the carriage incorporates a flange.




Seat Belt Tension Scenario

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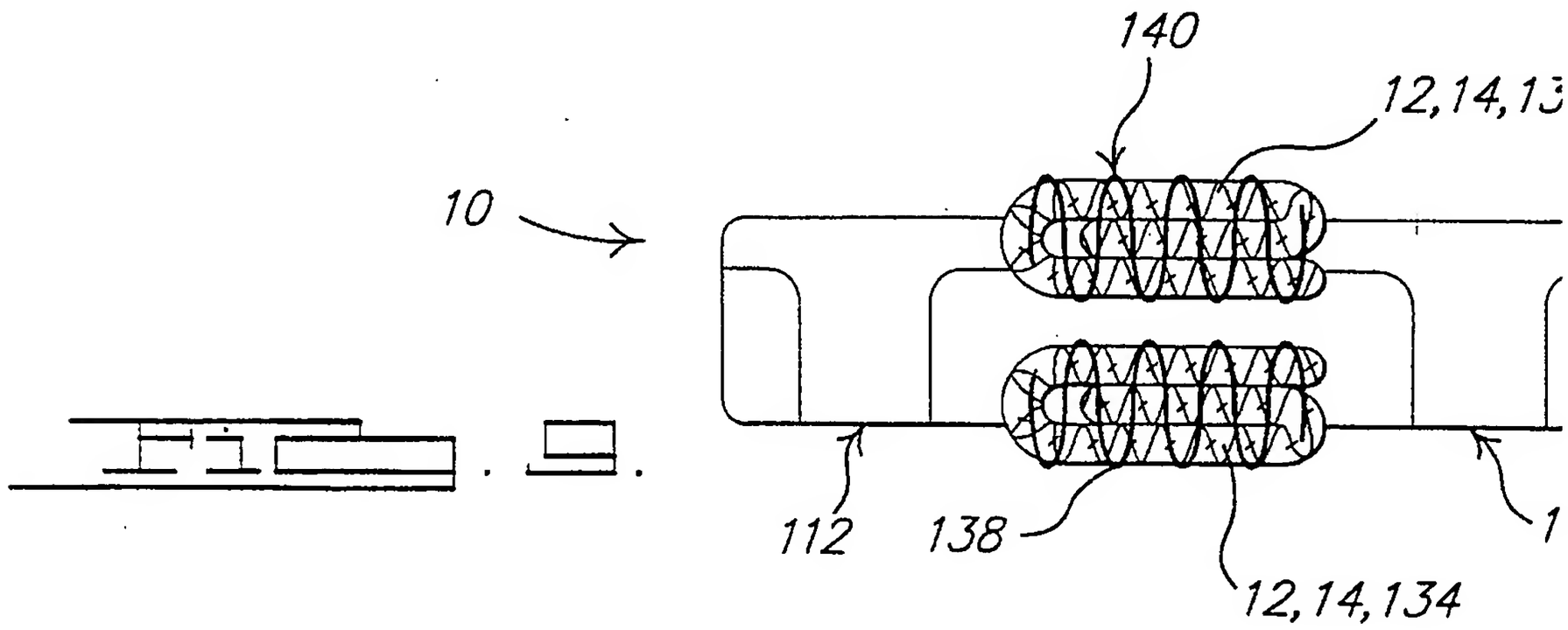
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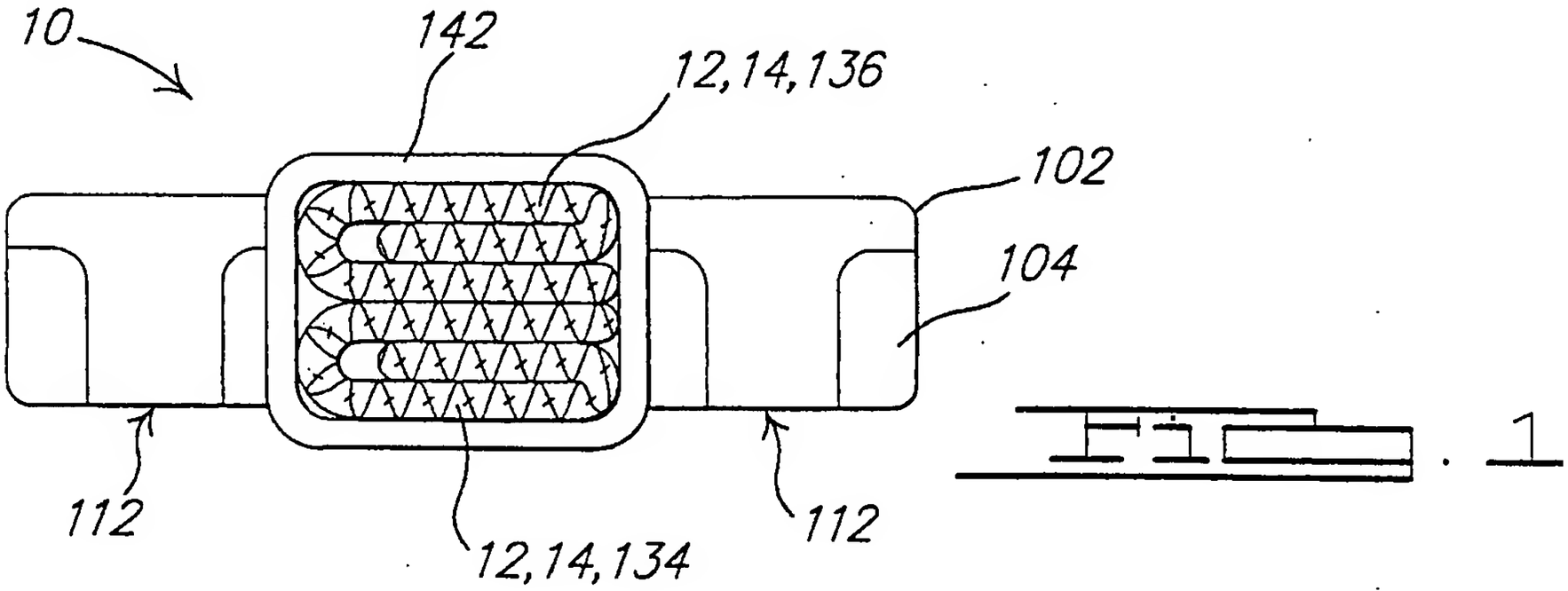
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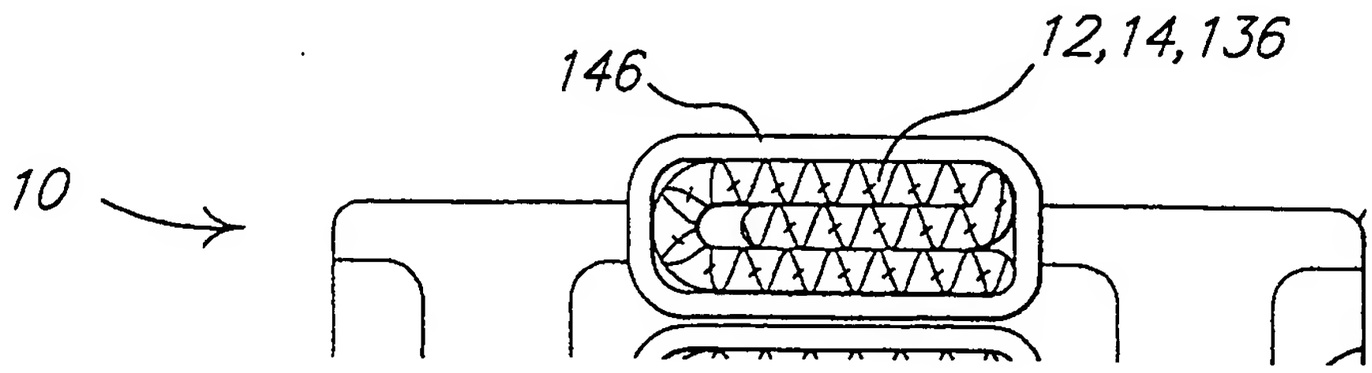
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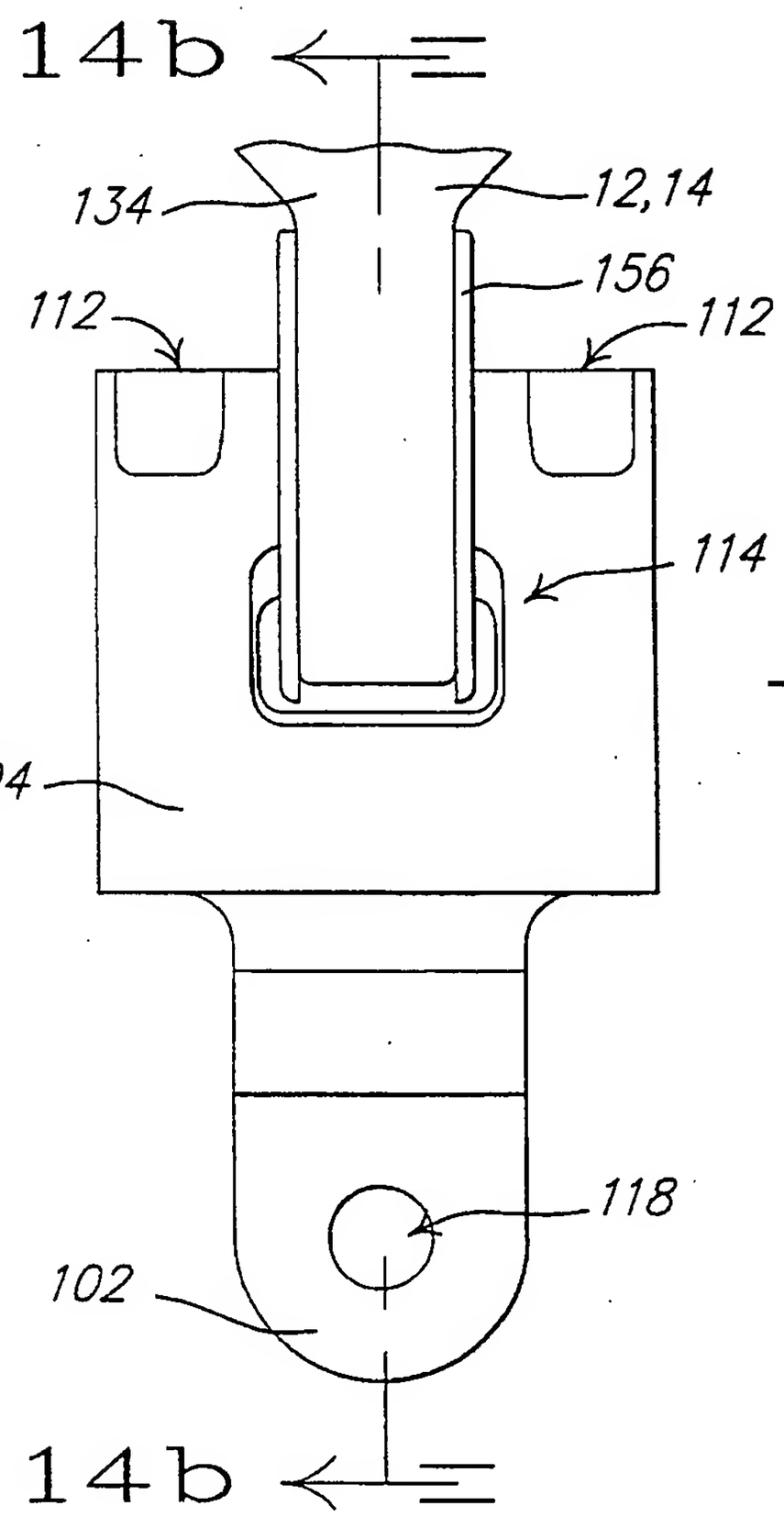
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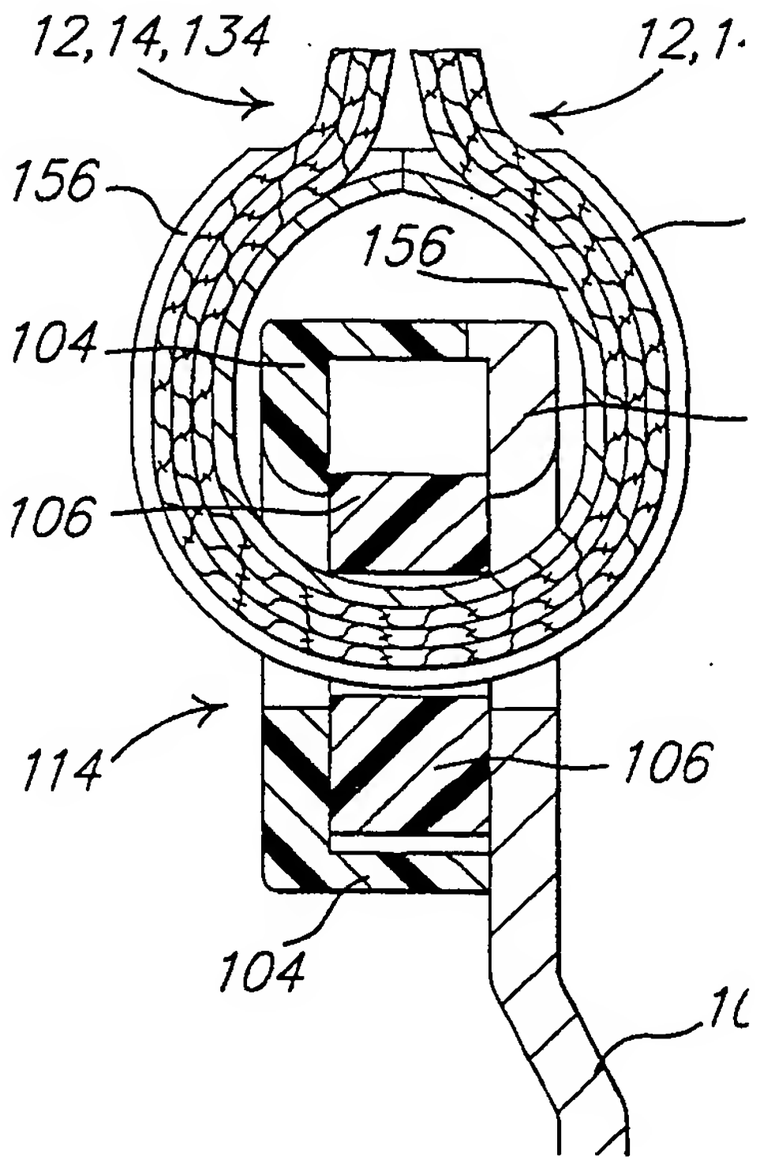
Fig. 14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| Title of Invention | METHOD OF ATTACHING A SEAT BELT TO A SEAT BELT TENSION SENSOR |

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Attorney Docket Number: 5701-01292

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